Geology 12

June 2001 Provincial Examination

ANSWER KEY / SCORING GUIDE

Topics:
1. Earth Materials
2. Time and Fossil Record
3. Internal Structures and Processes
4. Surficial Processes
5. Comparative Planetology

Part A: Multiple Choice

Q	K	C	T	PLO	Q	K	C	T	PLO
1.	C	U	1	B2	29.	C	U	3	K1
2.	A	U	1	B2	30.	C	U	3	K2
3.	B	H	1	B2, 3	31.	D	K	3	K3
4.	A	U	1	B3, 2	32.	D	U	3	K7, 1
5.	C	H	1	B3, 2	33.	B	U	3	K4
6.	C	U	1	C3, 2	34.	D	U	3	K7
7.	A	U	1	C4, 3	35.	B	U	3	L1
8.	B	U	1	C5	36.	A	U	3	M1
9.	A	U	1	C7	37.	B	U	3	N1, 3
10.	A	U	1	C8; E5	38.	B	U	3	N3, 2
11.	B	U	1	E1, 5	39.	A	U	3	N3
12	B	U	1	D3	40.	C	U	3	O3, 5
13.	D	U	1	D4	41.	D	U	3	O7
14.	C	U	1	E6	42.	B	H	3	O6
15.	D	K	1	F3	43.	C	U	3	O8
16.	A	U	1	F7	44.	A	U	3	O9, 6
17.	A	U	2	G2	45.	A	U	4	P2
18.	D	K	2	G2; A6	46.	C	H	4	P2; A7
19.	B	U	2	H1	47.	D	U	4	P4, 5
20.	C	U	2	H1	48.	C	U	4	Q3
21.	C	U	2	H4	49.	A	U	4	Q3
22.	C	U	2	I1	50.	C	U	4	Q4
23.	A	H	2	I2; G4	51.	D	U	4	R1
24.	B	H	2	I2	52.	B	U	4	R1, 2
25.	D	U	2	J2	53.	D	U	5	T3
26.	C	U	2	J5, 6	54.	B	K	5	T2
27.	B	K	2	J5	55.	D	U	5	T3
28.	D	U	2	J6, 5					

Multiple Choice = 55 marks

Part B: Written Response

Q	B	C	T	S	PLO
1.	1	H	1	1	B1
2.	2	H	1	3	D1, 3; E1, 2
3.	3	U	1	6	A5, 4
4.	4	U	1	3	F1
5.	5	H	2	4	G5
6.	6	U	2	7	J1, 3, 5, 6, 7; I1
7.	7	U	3	3	O7, 9
8.	8	U	3	7	N3; L3, 5; K1-4
9.	9	K	3	3	L1, 6
10.	10	U	4	2	R1
11.	11	H	4	4	S4
12.	12	H	5	2	T3

Written Response = 45 marks

Multiple Choice = 55 (55 questions)
Written Response = 45 (12 questions)
EXAMINATION TOTAL = 100 marks

LEGEND:

Q = Question Number
K = Keyed Response
C = Cognitive Level
B = Score Box Number
S = Score
T = Topic
PLO = Prescribed Learning Outcome

PART B: WRITTEN RESPONSE

Value: 45 marks **Suggested Time: 55 minutes**

INSTRUCTIONS: Answer each question in the space provided. You may not need to use all of the space given.

1. Oxygen and silicon are the two most abundant elements in the earth's crust. Support this fact using your knowledge of the abundance of common minerals and their composition. **(1 mark)**

Silicon and oxygen are the most common elements in the earth's crust because silicate minerals are by far the most abundant. } ← **1 mark**

REFERENCE DATA BOOKLET

For question 2, refer to the following in the Data Booklet.

page viii: Photograph 11

2. a) Photograph 11 shows a cut section of a **metamorphic** rock specimen. Suggest an appropriate name for this rock and its parent. **(1 mark)**

Metamorphic rock: **Metaconglomerate or stretched pebble conglomerate ($\frac{1}{2}$ mark).**

Parent rock: **Conglomerate ($\frac{1}{2}$ mark).**

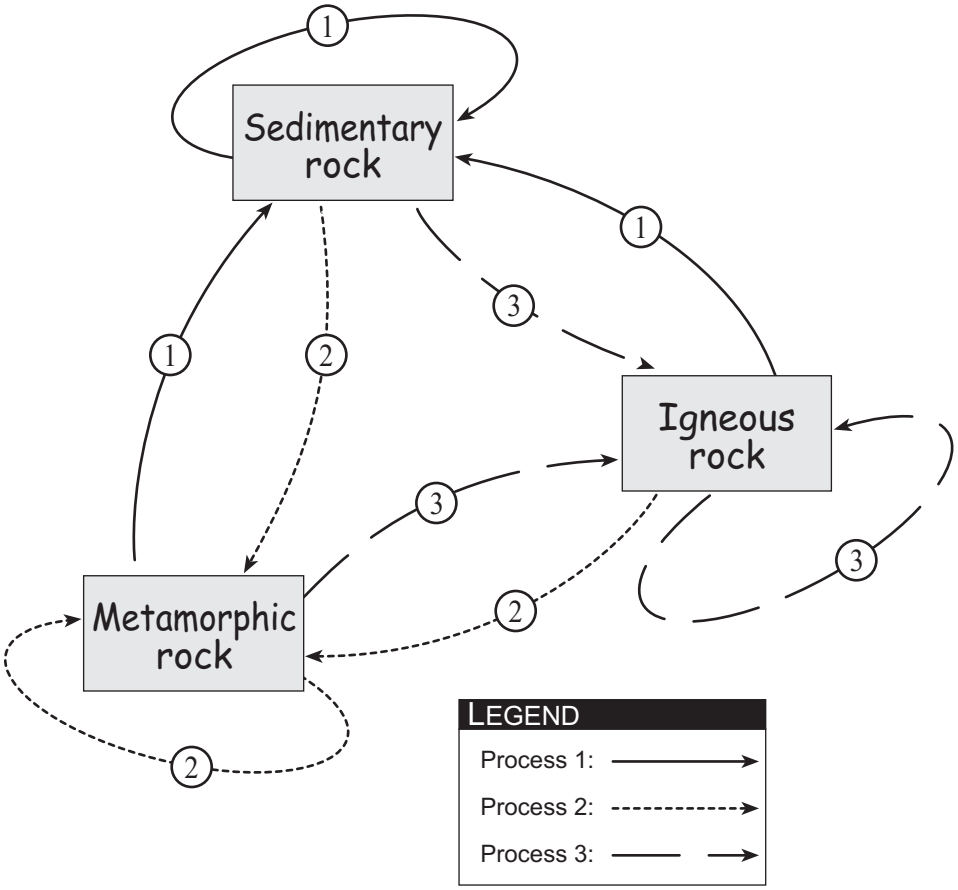
b) Describe evidence from the photograph that suggests this rock was metamorphosed. **(1 mark)**

The clasts/particles in the rock appear stretched and show alignment. This probably occurred during a period of heat and pressure, as a result of directed stress. } ← **1 mark**

c) Describe a typical environment in which the parent rock would form. **(1 mark)**

The parent rock would form in a high energy environment such as a beach or a river based on pebbles. } ← **1 mark**

Use the following diagram to answer question 3.



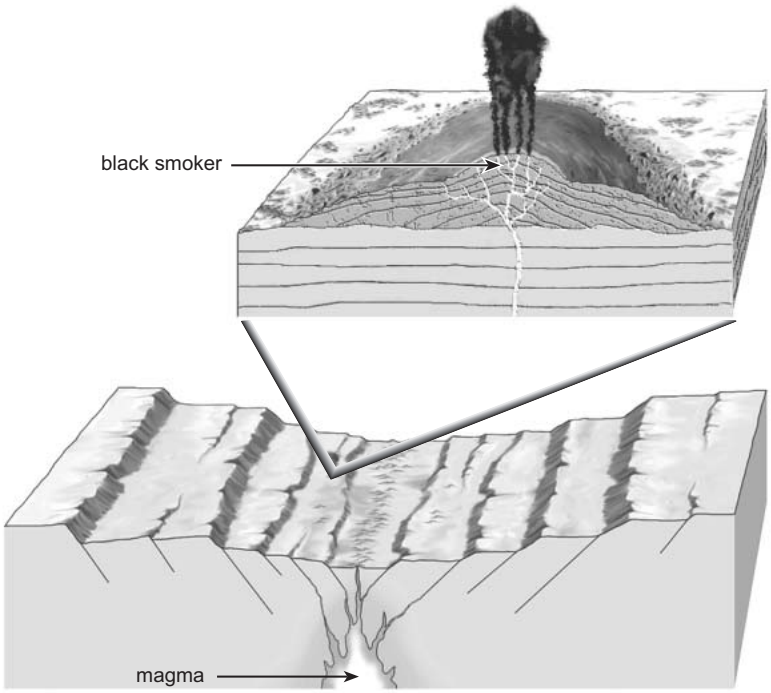
3. The rock cycle diagram above shows the relationships among the three major rock types. The diagram is missing information which describes the processes that change one rock type into another. In the space below, provide a **complete description** for each of the three processes. **(6 marks)**

Process 1 **involves weathering, erosion (1 mark), sedimentation and lithification (1 mark).**

Process 2 **involves heat (1 mark) and/or pressure (1 mark) which results in the formation of metamorphic rock.**

Process 3 **involves the melting of rock (1 mark) followed by cooling and crystallization (1 mark) to form igneous rock.**

Use the following diagram of an oceanic rift and a hydrothermal vent to answer question 4.



4. The diagram shows the formation of a hydrothermal vent (black smoker) on the sea floor near an ocean rift. Hydrothermal vents are thought to be an important way of forming certain mineral ores.

   a) Name **two** metallic minerals that might be formed by a black smoker in this environment. **(1 mark)**

Any *two* for 1 mark:

- **chalcopyrite**
- **sphalerite**
- **gold**
- **silver**
- **pyrite**
- **any of the sulphides**

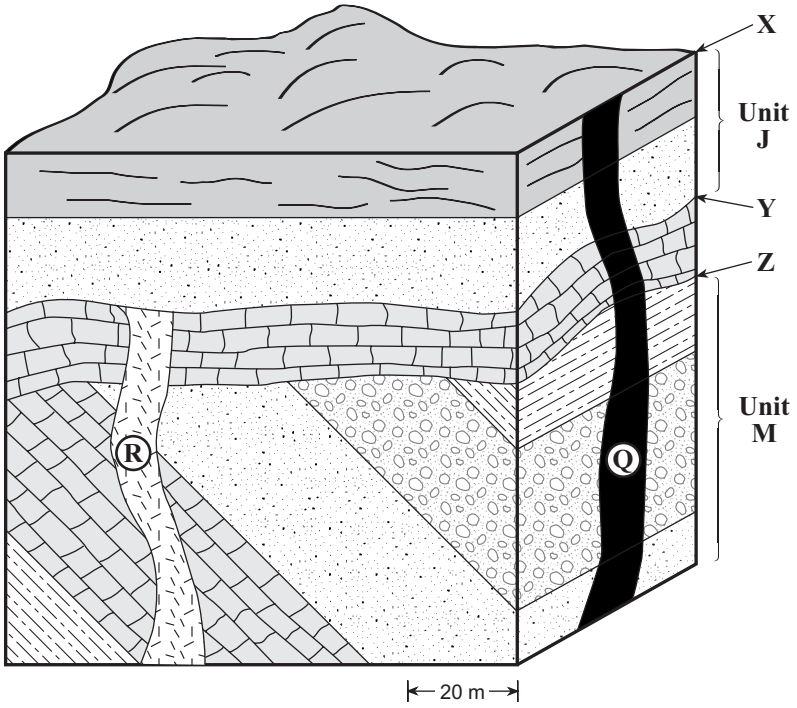
b) Describe how minerals are moved and eventually deposited in this environment. **(2 marks)**

Hot water moving through cracks in the crust dissolves minerals (1 mark).

These mineral-rich solutions rise by convection to the surface of the sea floor where they exit as streams of hot mineral-rich fluid $\left(\frac{1}{2}\right.$ mark$\left.\right)$.

These fluids cool quickly when they come into contact with the cold sea water and precipitate their mineral load $\left(\frac{1}{2}\right.$ mark$\left.\right)$.

Use the following geological block diagram to answer question 5.



5. The geological block diagram shows a series of geologic events involving intrusions, tilting, deposition and erosion. In the table below, the events are not listed in chronological order. Place a number beside each event to indicate the correct order, from oldest (1) to youngest (8).

(4 marks)

Event (not in order)	Order
Deposition of Unit M	**1**
Deposition of Unit J	**6**
Erosion of Surface Y	**5**
Erosion of Surface X	**8**
Erosion of Surface Z	**3**
Intrusion Q	**7**
Intrusion R	**4**
Tilting of Unit M	**2**

Marking:

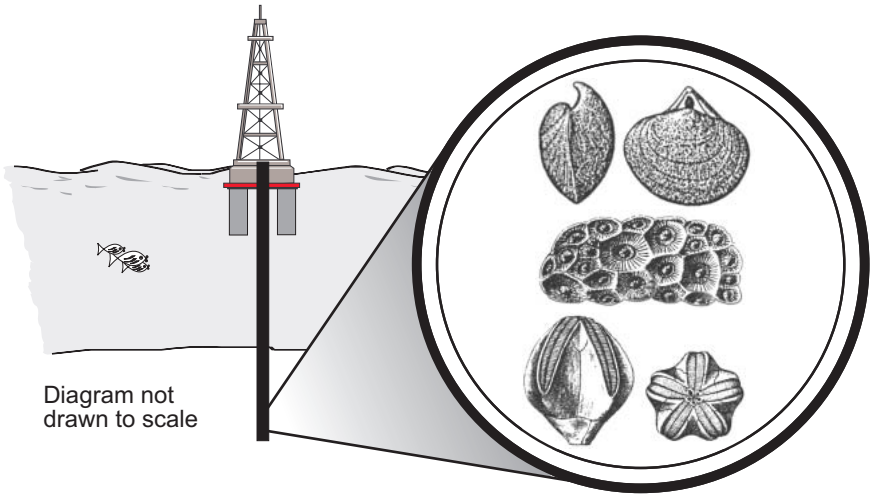
Relative age of intrusions	**1 mark**
Relative age of erosions	**1 mark**
Relative age of depositions	**1 mark**
Correct order	**1 mark**

REFERENCE DATA BOOKLET

For question 6, refer to the following in the Data Booklet.

page ii: Geological Time Scale
page iii: Fossil Samples
page iv: Development of Life Through Time

6. An offshore oil rig drills through a layer of rock that contains a number of fossils, as shown in the diagram below.



a) Name and describe **one** method of preservation for one of these fossils. **(2 marks)**

$\frac{1}{2}$ mark for name; 1.5 marks for description

Name: **permineralization**
Description: **dissolves silicate material and fills pore space**

Name: **replacement**
Description: **original material is replaced by mineral matter**

Name: **mold**
Description: **an imprint of the organism is left in sediment**

Name: **cast**
Description: **a mold is filled with sediment**

Name: **original material**
Description: **the original material of the fossil is preserved without change**

b) Give **two** reasons why it would be unlikely to find fossil 16 in this rock layer. **(2 marks)**

Fossil 16 is from a terrestrial plant and probably would not be found with the shallow ocean organisms represented in this fossil assemblage. } ← **1 mark**

Fossil 16 is from a different period of geologic history (1 mark).

c) What was the dominant vertebrate group at the time the rock layer was being deposited? **(1 mark)**

The dominate vertebrate group was the fishes (1 mark).

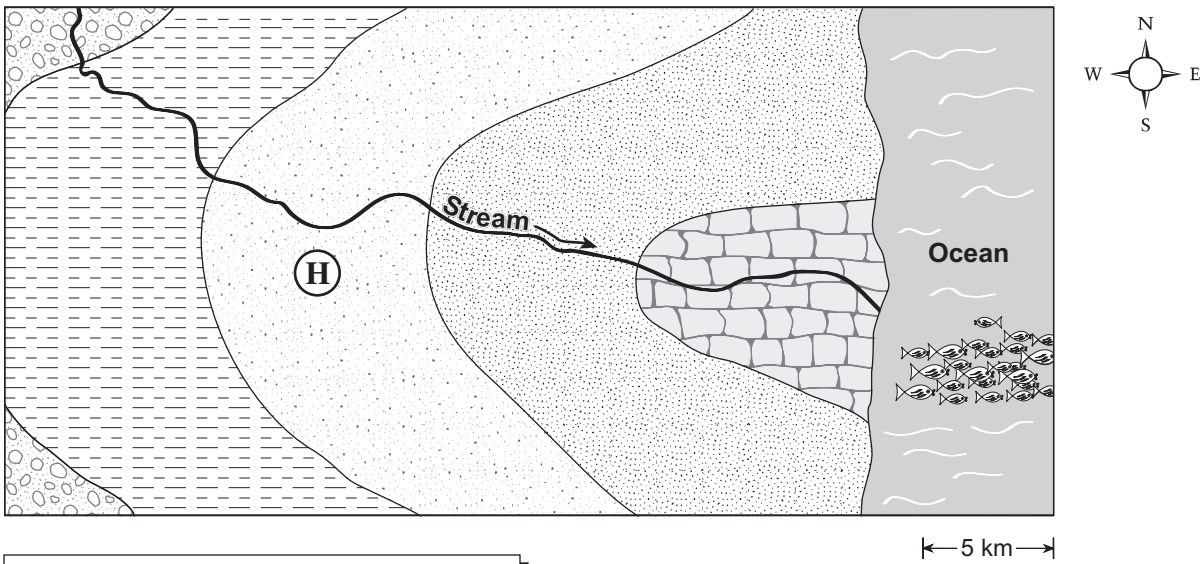
d) The Development of Life Through Time chart indicates that there was a dramatic change in the abundance of almost every group present at the end of the Paleozoic. Why did this change occur? **(1 mark)**

The decrease was due to mass extinction at the end of the Paleozoic (1 mark).

e) Although relatively abundant during the Paleozoic, jellyfish are generally poorly represented in the fossil record. Suggest a reason why. **(1 mark)**

Although great in number, jellyfish have no hard parts that would fossilize (1 mark).

Use the following sketch map of a geologic structure to answer question 7.



Rock Unit	Geologic period
Conglomerate	Pennsylvanian
Shale	Mississippian
Siltstone	Devonian
Sandstone	Silurian
Limestone	Ordovician

7. The geologic structure in the sketch map is a plunging anticline. The general topography of the area is reasonably level.

   a) Give **one** piece of geological evidence shown on the map that indicates the structure is an anticline. **(1 mark)**

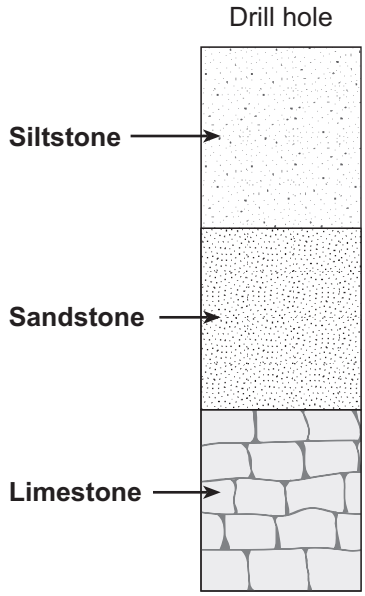
Anticlines have the oldest beds in the centre (1 mark).

   b) Give **one** piece of geological evidence shown on the map that indicates the structure is plunging. **(1 mark)**

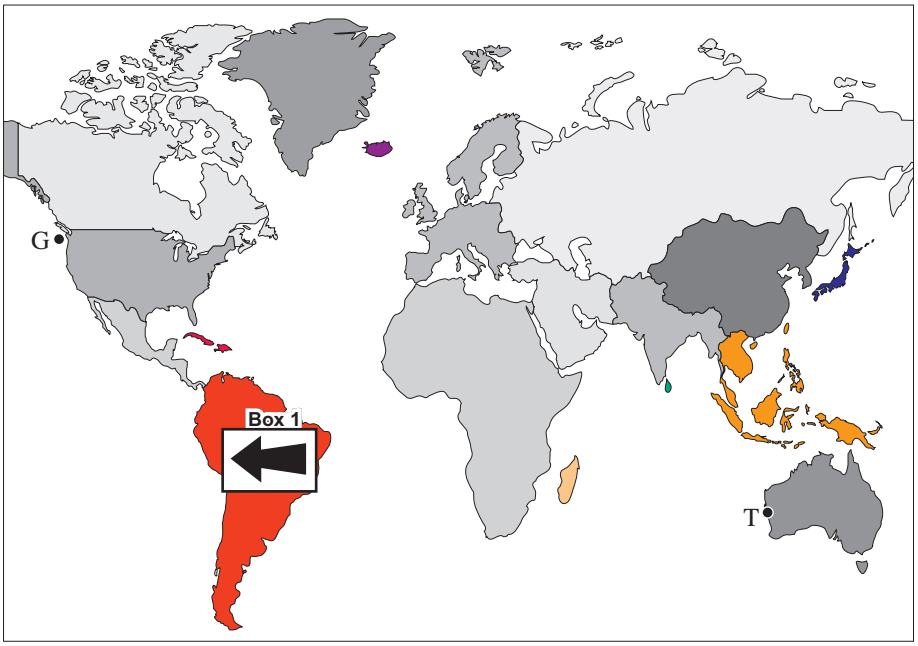
The surface contact between all layers is curved (semi-circular) (1 mark).

c) A vertical hole is drilled at location **H**. Complete the geologic column below by sketching the first three rock strata that would be encountered in the drill hole. Label the rock units.

(1 mark)



Use the following map to answer question 8.



8. a) A major earthquake with Richter magnitude 8.7 has occurred at location **G**. S- and L- (surface) waves were not detected at location **T**. **(2 marks)**

Why were S-waves not detected at location **T**?

T is located in the S-wave shadow zone. S-waves do not travel through the liquid outer core. ← **1 mark**

Why were L-waves not detected at location **T**?

Location T is too distant for surface waves to travel from location G. L-waves fade out. ← **1 mark**

b) Place an arrow in **Box 1** to indicate the direction South America is moving relative to Africa. **(1 mark)**

Arrow should point west. See diagram above (1 mark).

c) Explain your choice of direction in question b). **(1 mark)**

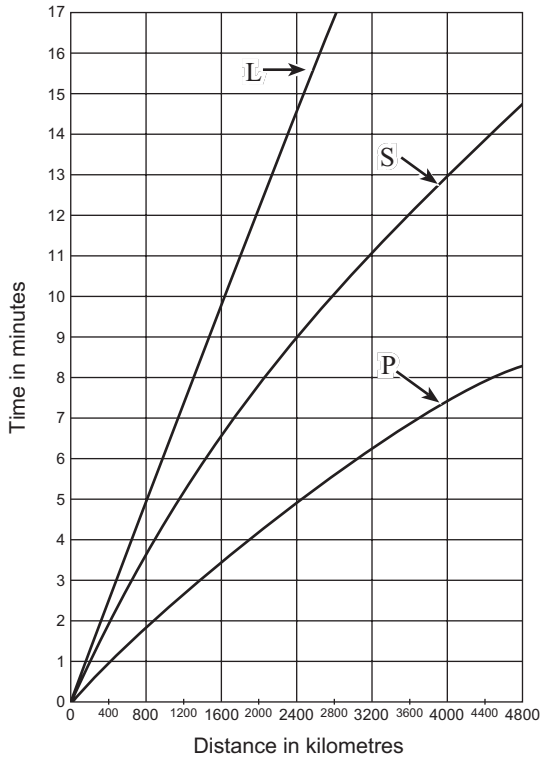
The spreading of the mid-Atlantic Ridge. Africa and South America are moving apart. ← **1 mark**

d) What type of plate boundary exists at location **G**? **(1 mark)**

The plate boundary at location G is a convergent plate boundary or a subduction zone. ← **1 mark**

e) A seismograph station determines the travel time interval between the first arrival of P- and S-waves at 4 minutes. Using the travel time graph below, determine the distance to the epicentre from this station. **(1 mark)**

Travel Time Graph



The distance from the epicentre from the station is 2 400 km (1 mark).

Note: 2 200 km – 2 600 km is accepted.

f) A seismograph station in Prince George (700 km from the earthquake) assigned the earthquake a Richter magnitude of 8.7. The same earthquake was assessed a low rating (II) on the Mercalli Intensity scale at Prince George. Give **one** reason why there would be such a difference between the Mercalli and Richter ratings. **(1 mark)**

Prince George is at a considerable distance from the epicentre (1 mark).

9. Three geologically active faults are located in a tectonically active region of south-western British Columbia. Each fault has its own history of seismic activity.

Fault A has had slow continuous motion over the past 30 years. Continuous micro-seismic activity has been recorded along the fault.

Fault B has had several small earthquakes during the past 30 years.

Fault C has had no earthquakes recorded during the last 30 years. However, historical evidence suggests that a large earthquake happened on this fault 150 years ago.

a) What is the name given to the type of fault motion shown by fault **A**? **(1 mark)**

The type of fault motion shown by fault A is called fault creep (1 mark).

b) Which fault is **most likely** to produce a large, damaging earthquake at some time in the future? Check (✓) one.

Fault A: ❒ Fault B: ❒ Fault C: ❒

With reference to all three faults, use geological principles to explain your answer. **(2 marks)**

Fault C: ☑ ($\frac{1}{2}$ mark)

Fault C has shown *seismic gap* and looks as if it is building up stress without relief. Fault B is relieving its stress through regular small earthquakes and Fault A is creeping, therefore it is not building up seismic stress. ← **1 $\frac{1}{2}$ marks**

REFERENCE DATA BOOKLET

For question 10, refer to the following in the Data Booklet.

page viii: Photograph 12

10. a) What is the name for the glacial feature labelled **X** in photograph 12? **(1 mark)**

The glacial feature is an esker (1 mark).

b) Briefly describe how the feature was formed. **(1 mark)**

An esker is a long, winding ridge of stratified sediment deposited by meltwater streams flowing under glacial ice, or in tunnels within the ice. ← **1 mark**

11. In the spaces provided below, describe how human activities affect both the quality and quantity of groundwater. An example is provided. Point form answers are acceptable. **(4 marks)**

Answers may vary. One word answers (i.e. pollution) are worth $\frac{1}{2}$ mark.

Human activity	Effect on groundwater quantity	Effect on groundwater quality
Example: *Septic tank fields*	***Example:*** *Large amounts of waste water are introduced into the ground.*	***Example:*** *Groundwater is contaminated by bacteria.*
1. Urbanization	• **a larger population means more demand, therefore greater quantities of groundwater are removed.** • **with urban sprawl there is more pavement created, therefore less water gets back into the ground (recharge).** • **subsidence caused by too much water being removed too quickly could constrict the aquifer.** **1 mark**	• **water that makes it back into the ground would most likely carry the effects of the city; i.e., pollution.** • **excessive withdrawal could lead to saltwater intrusion in coastal areas.** • **chemicals added to ground may filter into groundwater, i.e., salt on roads.** **1 mark**
2. Agriculture	• **farming requires huge amounts of water for irrigation.** • **farmland enables the water to get back into the groundwater system.** **1 mark**	• **pesticides and fertilizers used in agriculture seep into the groundwater system.** • **soil erosion may affect the stream systems which feed the groundwater supply.** • **animal effluent may reach groundwater.** **1 mark**

12. The moon has a more highly-cratered surface than the earth. Give **two** reasons for this difference. **(2 marks)**

Any *two* for 2 marks

- **There are no tectonics on the moon.**
- **There are no surface processes; i.e., wind, water, vegetation, freezing, thawing, etc. on the moon.**
- **There is no atmosphere on the moon.**
- **Earth is 75% water.**

END OF KEY